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ABSTRACT

This paper sets forth recommendations for the topics and organization of preservice and inservice teacher training activities on the use of microcomputers for instructional purposes. A review of the literature on the framework for staff development programs is presented, pointing out the salient characteristics of successful inservice education programs. Opinions were sought from teachers who were considered effective in the use of microcomputers for mathematics and science instruction. A synthesis of the responses of the teachers (both elementary and secondary level) is presented. Suggestions on the organizational features of a staff development program included: (1) voluntary participation; (2) clearly stated objectives; (3) activities which meet teachers' needs and plans in a timely manner; (4) courseware immediately applicable to teachers' instructional needs; (5) instruction individualized as far as possible; (6) an experienced instructor; (7) sufficient "hands-on" practice; and (8) some incentives. Recommendations for program content included: (1) operation of the computers; (2) selection and evaluation of courseware; (3) instructional uses of computers; (4) initial training to include computer "literacy"; (5) integration of computers with instruction; and (6) computer programming. It was also recommended that computer education be included in preservice teacher education programs. (JD)

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STAFF DEVELOPMENT FOR INSTRUCTIONAL USES OF MICROCOMPUTERS: THE TEACHERS' PERSPECTIVE

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April 1984

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I. STAFF DEVELOPMENT FOR INSTRUCTIONAL USES OF MICROCOMPUTERS: THE TEACHERS' PERSPECTIVE*

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INTRODUCTION

The lack of adequately trained teachers presents a major obstacle to the effective instructional uses of microcomputers in schools. For example, a survey of all school districts in California revealed that over 60 percent of the teachers using computers were either unprepared or inadequately prepared. Over three-fourths of the districts not using computers reported that faculty had practically no preparation in instructional computer use. For both using and non-using districts, lack of adequately trained teachers was second only to lack of funds as a factor that inhibited development of educational programs in computer-aided instruction (Stutzman, 1981). This shortage of trained teachers is clearly evidenced not only in California, but in other states (e.g., NEA, 1983) and nations as well (Cerych, 1983). Moreover, few districts have the facilities, resources, staff, and reward structure to offer a systematic training program for microcomputer-based instruction (Sturdivant, 1983). Although staff development efforts are evident in almost all districts and schools implementing microcomputers for instructional use, such efforts typically fall short in the number of teachers trained, in the length of training, in the amount of "hands-

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on" experience provided in the topics covered, and in the provision of in-class follow-up after the staff-development activity.

A number of factors contribute to these limitations in the effectiveness of staff-development programs. One is the rate at which microcomputers have entered our schools. One estimate showed an increase of over 230 percent from Fall 1980 to Spring 1982 (NCES, 1982). And recently, every school in the state of California received a free microcomputer from the Apple Corporation.

A second factor is the number of teachers who require training. Although the number of computer-related courses offered at teacher-training institutions is increasing, the vast majority of teachers do not receive this preservice education in computer use (Issacson, 1981; Chambers & Bork, 1980). For example, in a national survey of 1200 teachers, only 11 percent reported receiving some computer training in college or university (NEA, 1983). Very few schools of education have changed their requirements to ensure that every graduating teacher is competent in the use of microcomputers (NIE, 1981). One study estimated that only five percent of the approximately 1,350 teacher training programs in the country offered such courses (Benderson, 1983).

At a time when the need for teachers proficient in microcomputer use is increasing, the provision of preservice education in this area is hampered by an aging teacher force, by decreasing enrollments in schools of education, and by decreasing federal spending for education. This means that the degree to which preservice teacher-education will fill this great training gap depends not on need but on economics. Teacher-education institutions will base curricular decisions, in large part, on whether enrollment of able men and women will increase if a major investment is made to develop courses and programs in microcomputer applications (Sherwood, Connor, & Goldberg, 1981).

But, even if preservice education were more widespread, new staff are not being hired by economically pressed school districts (Benderson, 1983; McLaughlin & Marsh, 1979). As a result, most schools and teachers have little experience with computers. The greatest training gap lies in the present teaching corps and must be filled through inservice staff development.

Finally, the third factor limiting microcomputer use and effectiveness is our lack of knowledge about and agreement on the topics and organization of staff development programs. Districts and schools have employed many different models for staff development, but they lack vital information about factors that lead to successful implementation and effective instructional uses of microcomputers (Sheingold, 1981). For example, what content should be covered in the training? Obviously, teachers need to know how to operate the computer and to load and save instructional programs (courseware). But does every teacher need skills in evaluating courseware, in computer programming, and in successfully integrating computers into regular, ongoing instruction?

With regard to the organization of staff-development programs, a number of questions beg for answers: How much training is needed to enable teachers to use microcomputers effectively? Should courses be held locally to ensure better attendance or at a site that accommodates a large number of computers for hands-on practice? Do incentives, such as release time or salary credits, ensure better participation in and implementation of staff-development activities?

This paper sets forth recommendations for the topics and organization of preservice and inservice teacher training activities based on a review of the literature on staff development, on our observations in the field, and on the opinions gathered from 60 microcomputer-using teachers who were nominated as "successful" users of microcomputers in mathematics and science instruction.

OVERVIEW OF THE STUDY

The data discussed in this paper were collected as part of a larger study of microcomputer-based mathematics and science instruction in elementary and secondary schools (Shavelson, et al., forthcoming). During the spring semester of 1983 we visited 49 schools in 25 California school districts and interviewed teachers, principals, and district or county administrators concerning the implementation and uses of microcomputers for mathematics and science instruction in their schools. Although the interviews covered many issues, here we focus on those regarding staff-development activities.

Teachers were asked whether the school or district provided any staff development or training, the content and organization of these programs, whether they participated in the training, and what kinds of inservice and preservice programs would be valuable for training.

An important purpose of the larger study was to identify the patterns of microcomputer use by successful teachers. We defined successful computer use as the appropriate integration of microcomputer-based learning activities with the teachers' instructional goals and with the ongoing curriculum, which changes and improves on the basis of feedback that indicates whether desired outcomes are achieved.

From this definition we identified 12 variables to characterize teachers' microcomputer-based instruction. Four variables concerned teachers' subject-matter goals and the degree to which they stressed microcomputer use for mastery of basic skills, cognitive understanding, motivation, and management. The fifth variable indicated whether teachers viewed students' use of microcomputers as a unique goal. Three variables were related to the ongoing curriculum: the extent to which the microcomputer was used for instruction, the degree to which teachers coordinated computer-based activities with other learning activities (e.g., worksheets, textbook), and the degree to which they integrated computer activities with the subject matter. Microcomputer-based instructional activities were indexed by three variables: the number of different modes used (e.g., drill-and-practice, tutorial), the number of students typically assigned to the computer, and whether or not students were assigned equal time on the computer. Finally, we asked teachers if and how they modified their instruction based on feedback.

We gathered data on these variables and created a profile for each teacher. Selected variables from these profiles were used in a cluster analysis (Kettenring, et al., 1976) to identify four clusters (see Shavelson, et al., forthcoming, for more details regarding the method and results of the cluster analysis).

Teachers in the *orchestration* cluster (N=18) tended to coordinate microcomputer activities with other classroom learning activities, stressed mastery of basic skills but also held unique goals for microcomputer use, grouped students in various arrangements at the

computer, altered instruction based on feedback, and used a variety of instructional modes.

Teachers in the second cluster, labelled *enrichers* (N=23), also encouraged microcomputer use in its own right. They were likely to use microcomputers in other subject areas or for other instructional purposes, such as word processing. They did not, however, try to coordinate microcomputer use with other classroom activities; nor did they strive for broad coverage of the subject-matter with the computer. Enrichers made little use of the computer for teaching basic skills.

Teachers in the *adjunct instruction* cluster (N=14) were more likely to have students work in groups of two or more than other teachers were. These teachers stressed the acquisition of conceptual knowledge and skills, and limited computer use to a single subject area. They tended to selectively augment certain lessons, stressing conceptual knowledge, with what little courseware might be available.

Teachers in the *drill-and-practice* cluster (N=5) were characterized by extensive coordination between computer and class activities, and by emphasis on basic skills. However, they did not hold unique goals for computer use; used one or, at most, two modes of instruction; did not change instructional use based on feedback; and only assigned students to the microcomputer one at a time.

Before presenting the teacher data, we discuss the literature on staff development in general and on staff development for computer-based instruction to determine what it suggests for designing staff-development activities.

STAFF DEVELOPMENT FOR MICROCOMPUTER USE: THEORY AND RESEARCH

Despite the pervasiveness of staff-development programs in our districts and schools, there are very few research studies with staff development as a primary focus (Griffin, 1983). Thus, in attempting to answer the question, "What comprises good staff development for microcomputer-use?" we adapted a conceptual framework for analyzing staff-development activities proposed by Fenstermacher and Berliner (1983).

Framework for Staff Development

Following Fenstermacher and Berliner (1983, p. 4) we defined staff development as "The provision of activities designed to advance the knowledge, skills, and understanding of teachers in ways that lead to changes in their thinking and classroom behavior" regarding microcomputer-based instruction. To place this definition within the organizational context of schools, we assume that staff-development activities may be "internally proposed or externally imposed, in order to effect compliance, remediate deficiencies, or enrich the knowledge and skills of individual teachers or groups of teachers, who may or may not choose to participate in these activities" (Fenstermacher & Berliner, 1983, p. 4). Together, the definition and assumption constitute our framework for understanding what comprises good staff development in microcomputer use, regardless of the particular content of the staff-development activity itself.

A valuable staff-development activity for microcomputer-based instruction must first fit our definition (Fenstermacher & Berliner, 1983). That is, it must enhance knowledge, skills and understanding in ways that lead to changes in thought and action. The value can be further determined by considering the four important features of the organizational context assumed above. How was the activity initiated? For what purpose? Who participates? How is participation decided?

The literature on staff development highlights two of these features as important concerns regarding staff development for microcomputer-based instruction. The first concerns whether a *top-down* or *bottom-up* initiation of staff development leads to more valued consequences. In a top-down situation, staff development can be externally initiated (e.g., by the superintendent) for the purpose of enrichment (or compliance), with all teachers required to participate. In a bottom-up approach, staff-development activities may be initiated by teachers who participate voluntarily in order to learn about and use microcomputer-based instruction. We observed both initiation modes in our fieldwork. There is some evidence that bottom-up initiation is more likely to provide activities that teachers will more readily view as valuable contributions to their knowledge, skills, and understanding of

microcomputer-based instruction (Fenstermacher & Berliner, 1983). This occurs, in part, because the small-scale staff-development activity provided by an experienced teacher can flexibly accommodate other teachers' schedules and adapt to the trainees' needs and problems. Some district involvement, however, may be necessary, especially in light of the financial commitment involved. Once computers are in place, it also seems reasonable for the district to build on the staff-development activities that have been initiated by teachers to ensure successful implementation of microcomputer-based instruction in other schools.

A second concern is whether participation should be mandatory or voluntary. Although simply mandating a program does not necessarily diminish its potential value, voluntary participation seems to have a more salutary effect on implementation (e.g., Berman & McLaughlin, 1978; Fenstermacher & Berliner, 1983; Griffin, 1983). Voluntary participation in staff development for microcomputer-based instruction seems feasible and reasonable since its purpose is for enrichment rather than compliance-effecting (e.g., to learn new regulations regarding mainstreaming handicapped children) and since computer use typically involves a large commitment of time and energy on the teachers' part. Finally, some teachers may have legitimate objections to computer-based instruction; e.g., they might teach subjects for which courseware in sufficient number and quality is not available.

Considering solely the definition of and assumptions about staff development by themselves, we can only make weak predictions about the value of the activities. Clearly, some activities initiated in a "top-down" manner can be successful, especially if care is taken in enlisting teacher support for them. Fenstermacher and Berliner (1983), however, further specified a number of conditions for staff development which, if met, contribute significantly to the value of such activities and the predictability of their success. The conditions most germane for this study are set forth in Table 1 as recommendations for staff-development activities for microcomputer-based instruction.

Applying the conditions in Table 1 to staff development in microcomputer-based instruction, we define a good staff-development program as one that is designed to enhance the teachers' knowledge and skills in ways that lead to changes in their thinking (planning and

Table 1

RECOMMENDATIONS FOR STAFF DEVELOPMENT IN MICROCOMPUTER-BASED INSTRUCTION

Condition	Recommendation
(1) Sensibility	The activity is consistent with plans teachers have for their work, fits well with classroom circumstances, is timely, and is valued for its utility.
(2) Variability	The activity permits variation in the ways teachers participate and in ways they use what they have learned.
(3) Incentives	The activity provides positive incentives to recipients for their participation, both during the activity and during its implementation in the classroom.
(4) Maintenance	The activity provides systematic and clinical support during the activity and during the period of implementation in the classroom.
(5) Objectives	The activity has clearly stated objectives known to both providers and recipients and clearly related to work demands on the recipients.
(6) Instructor	The activity is staffed by providers who have competence in teaching adults, and the instructor is able to model what it is proposed that recipients do in their work settings.
(7) Application	The content of the activity is sufficiently concrete to make its application to the classroom clear.
(8) Duration	The activity provides sufficient time for recipients to learn, practice, master, and apply the content imparted.

decisionmaking) and microcomputer-based instruction. These changes in thought and instruction should be supported throughout the school district by teachers and administrators alike. Such a staff development

program will have clearly stated goals (5)* that are consistent with teachers' perceived needs, plans for their work, and classroom teaching conditions (1). The activity should permit variation in the ways teachers participate in the activity and apply microcomputer-based instruction in the classroom (2). The content of instruction on microcomputer use should be concrete (7), and its application to the classroom (or microcomputer laboratory) should be demonstrated by an instructor who is competent in teaching adults and who is able to model microcomputer-based instruction in the context of an ongoing curriculum (6). The duration of the program should permit teachers sufficient time to learn, practice, master, and apply in the classroom or laboratory the knowledge and skills imparted (8). It should provide systematic, clinical support during the activity and during the period of implementation (4). Finally, teachers should receive positive incentives for their participation during the training, implementation, and institutionalization phases of microcomputer-based instruction (3).

Content and Other Organizational Features

While the framework provided by Fenstermacher and Berliner (1983) identifies important organizational structures and processes for staff development activities, it was not intended to identify the content of staff development for microcomputer-based instruction. For this information, plus other insights about organizational issues, we examined literature on staff development for microcomputer-based instruction. As expected, few studies have been conducted on this topic. Those that have been reported tend to be case studies rather than comparative studies that systematically varied important characteristics of training such as the organization, content, instructional method, incentives, and support for microcomputer-based instruction. These case studies suggest at least three alternative forms of staff development considered to date.

The most prevalent form of staff development is the one-shot, short-term workshop for interested teachers (e.g., Sobol & Taylor, 1980). These workshops, often offered at a central site in the district, last

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* Numbers in parentheses correspond to recommendations listed in Table 1.

2-3 hours for each session and are carried out over a period of a few days to a week. These workshops are often led by computer-education experts from a local university. They most often teach about how to operate the computer and how to write elementary programs, familiarize teachers with the range of courseware available, and provide limited guidance in the selection and/or modification of courseware.

A second approach combines the one-shot, short-term workshop with one or a few additional, focused workshops that are directed to participants' special needs. This approach often includes an introductory course, like the type described above, with additional courses in more advanced computer programming or non-instructional uses of the microcomputer, such as student recordkeeping. The courses are typically taught by a resource person in the school district (e.g., Page & Wallig, 1983).

A third approach is to train a small cadre of teachers who then provide workshops and individualized training in microcomputer-based instruction to their colleagues (e.g., the Minnesota Educational Computing Consortium, reported in OTA, 1982).

In addition to individual case studies of specific staff-development activities, some information about the content and processes of staff development can be obtained from comparisons of case studies. One such analysis was carried out by Sheingold (1980) who systematically compared case-study data from three school districts, focusing, in part, on the content and organization of staff development. With regard to content she found that teachers wanted sufficient time to review courseware and to plan how to match courseware with students' abilities and learning styles. As for organizational factors, time was a critical issue for many teachers. Even those teachers who had access to workshops, courses at nearby colleges, and colleagues or resource personnel knowledgeable in microcomputer-based instruction, sought additional time to personally use the machines so as to adequately plan instruction.

A survey conducted by the National Education Association (NEA, 1983) provided further information on teachers' perceived needs for staff development in computer use. The NEA asked a sample of 1200 computer-using (n=75!) and "non-using" teachers to check those topics

they were interested in learning more about from a list of 13 topics. Over half of the teachers expressed interest in: instructional applications of computers, how to operate them, and how to write computer programs. About 40 percent were interested in information on courseware and hardware selection, and on different programming languages. Topics less frequently checked included "curriculum design for computerization [sic], K-12 computer science curriculum, educational policy for computers, computer user network, how to teach computer science, computer history and courseware copyright protections" (NEA, 1983, p. 18). On all but three of these topics, users were significantly more interested in learning about the computer-related topics than were non-users. The three topics on which the percentage of interested users and nonusers did not differ were: educational policy (25.3 and 20.8 percent, respectively), hardware selection (38.7 and 40.2), and computer operation (57.3 and 58.9). These findings might reflect differences in needs, not just interests, so that topics included in staff-development programs might vary according to teacher experience or computer expertise.

The findings from the review of staff-development approaches, research on staff-development for computer use, and the NEA survey are summarized as a set of recommendations for the content and organization of staff development in microcomputer-based instruction in Table 2. The topics--microcomputer operation, computer programming, computer literacy, and selection and evaluation of courseware--might form the core of a staff-development program. Other topics are not necessarily less important, but perhaps reflect the extensiveness and variety of information that can bear on microcomputer-based instruction. The variety reflected by these remaining topics highlights the importance of organizing different staff-development activities based on teachers' needs.

Summary of Important Issues and Recommendations

The topics and organizational features (Tables 1 and 2) provide a beginning for formulating recommendations for staff-development in microcomputer-based instruction. Before considering the recommendations made by teachers in our study, we highlight some issues and

Table 2

TOPICS AND ORGANIZATIONAL FEATURES OF
STAFF DEVELOPMENT FOR MICROCOMPUTER-BASED INSTRUCTION*

Topics

(8) Operation of the microcomputer and peripherals

(9) Computer programming

(10) Selection and evaluation of courseware

(11) Modification of courseware

(12) Computer literacy (e.g., history, types of programming languages)

(13) Non-instructional uses of the microcomputer (e.g., management)

(14) Integration of microcomputer-based instruction into the curriculum

(15) Design and authoring of courseware

(16) Match of courseware with student abilities and learning styles

(17) Selection of hardware

(18) Computer science curricula and teaching computer science

(19) Development of a user network

(20) Copyright protection issues

(21) Instructional uses of microcomputers

Organizational Features

(22) Staff development located at a central site

(23) Staff development provided in either single or multiple sessions, (24) depending on topics covered

(6) Instruction provided by outside consultant, teacher or district personnel who meets the instructor condition set forth by Fenstermacher and Berliner (1983)

(27) Training adapted to teachers' needs and interests

(28) Extensive hands-on practice provided

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*Numbers in parentheses denote recommendations numbers and are referred to in the text.

recommendations that we deem to be particularly important or that have been emphasized in the literature.

Perhaps the most hotly debated issue is whether to include computer programming in introductory staff-development activities that have, as a goal, providing teachers with the knowledge and skills needed to use microcomputer-based instruction. While some advise that instruction in programming at the introductory stages is to be avoided (e.g., Hamolsky, 1983; Nanson, 1982), others assert that programming is essential for teachers (or anyone) to become computer literate (e.g., Luerhmann, 1981). Between these extremes are those who advocate some introduction to a programming language (usually BASIC) as a way to understand what computers and programming are about (e.g., Page & Wallig, 1983; Widmer & Parker, 1983).

This issue is part of a larger concern on the part of educators and others to define computer literacy. However, the lack of a generally accepted definition has not prevented interested groups from declaring minimum competencies which all teachers should have to teach effectively in a society permeated by computers (Poirot, 1980; Benderson, 1983). For example, a report by the Elementary and Secondary Schools Subcommittee of the Association for Computing Machinery asserts that teachers should be able to read and write simple programs that work correctly and understand how programs and subprograms fit together into systems (ACM, 1980). We suspect that this issue will intensify as more teacher education institutions begin to require computer courses in their preservice programs (e.g., Ramquist, 1983) and as states consider computer training as a prerequisite for obtaining teaching credentials.

The teacher decisionmaking perspective that guides this study suggests a second essential content area for staff development. Namely, teachers need enough information about the computer and courseware to make reasonable decisions for integrating microcomputer-based instruction into the ongoing curriculum. Although integration is an important element of successful use, our review found few examples of staff development that included this topic.

The most pressing organizational issue concerns teacher incentives. Presently, some school districts use a variety of incentives to maximize teacher participation in staff-development programs, outside computer courses, conferences and other activities that broaden their computer experience and expertise. These incentives include incremental salary credit (Sheingold et al., 1981; Page & Wallig, 1983), reimbursement for outside courses (Coburn, et al., 1982), release time (NEA, 1983; OTA, 1982), and new job titles with higher salaries for technically experienced teachers (OTA, 1982). After initial training, other organizational incentives, such as providing computer-resource personnel (Sheingold, et al., 1981), loaning computers to teachers over weekends, vacations and summers (Sherman, 1983), and subsidizing teachers to author courseware (OTA, 1982), encourage teachers to continue building their computer knowledge. While most of the evidence indicates that incentives motivate teacher participation in staff development and encourage their continued interest in microcomputers for instruction, little is known about which incentives (or combination of them) are most effective. Because preparing teachers to use microcomputers, as in preparing anyone to learn a new skill, involves a personal investment of time and energy, it is important to examine the incentives for such an investment (Sheingold et al., 1981). Research has shown that some incentives, such as salary credits, are meaningless to teachers who have already reached salary limits (Sheingold et al., 1981). Indeed, better working conditions may be even more important to teachers than higher salaries (Boyer, 1983). The incentive issue is particularly timely, since the federal government is considering various teacher incentives, such as merit pay for teachers who reach certain standards of excellence, and financial support for current teachers to upgrade their skills and knowledge. Such incentives are expected to aid recruitment, retention and retraining of highly qualified teachers in mathematics, science, and technology.

TEACHERS' RECOMMENDATIONS FOR STAFF DEVELOPMENT

We asked teachers to describe their ideal inservice-training program for microcomputer-based instruction. More specifically, we asked them to comment on the content or topics that should and should not be included in staff development for microcomputer-based instruction, and on organizational features of such staff development, especially location, duration, and incentives. We also asked whether the content of preservice education should differ from that of inservice education, and, if so, in what ways.

The questions were open ended because we sought breadth and creativity in response. All of the teachers' content recommendations were coded into predetermined categories, based on the content of staff-development programs reported in the literature and on our framework for staff development.

Our analyses initially focused more on whether staff-development recommendations varied systematically according to teachers characterized by grade level and different patterns of microcomputer-based instruction than on the frequency with which teachers concurred on various topics or organizational features. Accordingly, we examined recommendations by grade level (elementary vs. secondary) and by the way teachers used microcomputers for instruction (cluster). We expected, for example, that elementary and secondary teachers might have different staff-development needs because of the obvious organizational differences between the two levels. Furthermore, teachers who orchestrate microcomputers with the ongoing curriculum might have different recommendations for staff development than teachers who use the computer primarily for drill-and-practice. Orchestrators, for example, might suggest integration of multiple instructional uses as an important topic, while drillers might recommend previewing and selecting courseware to fit into their curricula.

Although the data lend themselves to groupings by grade level and cluster, the frequency counts for any particular recommendation are often too small to permit statistical tests. We performed such tests whenever feasible. Thus the patterns of data reported must be considered tentative. Our goal here is to show the range of teacher

responses and to provide as much information as possible about teachers' ideas on staff development. The data and patterns of responses might suggest possible relationships among grade levels, teaching methods and staff-development needs that could be more directly and more systematically tested in future studies.

Content Recommendations

Teachers' recommendations for the content of staff development, shown in Table 3, did not, by and large, differ by grade level or patterns of instructional use. The topics most frequently mentioned by teachers were consistent with the findings of the literature review: operation of the microcomputer, computer programming, and selecting and evaluating courseware. Teachers were less concerned with instructional uses of the microcomputer, computer literacy, integration of the microcomputer with instruction, and administrative uses. Other topics mentioned by teachers were modification of existing programs, word processing, on-line databases, utility programs, and starting a computer club. These exemplary teachers, then, recommended essentially the same "core" topics for staff development as reported in the literature.

Table 3

TEACHERS' RECOMMENDATIONS FOR THE TOPICS OF STAFF DEVELOPMENT

Item	Cluster 1	2	3	4
9[+] Programming	+	+	+	+[*]
29 No programming	+	+	+	+
8 Operation of microcomputer	+	+	+	+
10 Selection/evaluation of courseware	+	+	+	+
21 Instructional uses	+	+	+	+
12 Computer literacy	+	+	+	+
25 Integration with instruction	+	+	+	+
13 Administrative uses	+	+	+	

[*] The plus sign (+) denotes that members of the cluster mentioned the item

[+] Numbers in front of each item refer to recommendations set forth earlier.

That some teachers did not want programming included in staff development is noteworthy, both because of the controversy surrounding its inclusion in training for instructional uses of microcomputers, and because it was the only topic to receive any definite "no" votes from the teachers. Moreover, 18 teachers, mostly elementary teachers, did not mention programming at all. This suggests that elementary teachers did not consider programming important enough to include it as a topic in staff development for microcomputer-based *instruction*.

Organizational Recommendations

Teachers' recommendations regarding the organizational features of staff development can be summarized succinctly as a series of meetings, held during school hours or after school, located on-site, averaging about 13 hours in duration with as much hands-on practice as possible. One additional recommendation was to involve students in the staff-development activity as a way to see how the courseware works with its intended audience (see Table 4).

The teachers also recommended varying staff development activities in level of sophistication and topic, in order to meet the needs of teachers at different stages of microcomputer use. For example, they suggested that programming be offered as more advanced instruction for teachers who wanted to learn that skill. And they recommended organizing workshops around specific topics so that teachers could attend only those sessions that fulfilled their needs.

Fewer than half of the teachers mentioned staff-development incentives; of these, one-third said they were not necessary. Teachers who opposed incentives felt that they would encourage some teachers to become involved for the wrong reasons. Teachers who supported incentives thought salary credits or release time should be given. One unique suggestion was to give credits to purchase computers or courseware.

Few teachers mentioned whether participation in staff development should be mandated. Research and conventional wisdom suggest that the goals of staff development will more likely be met if teachers choose to participate (Fenstermacher & Berliner, 1983). We found that voluntary

Table 4

TEACHERS' RECOMMENDATIONS FOR ORGANIZATIONAL FEATURES OF STAFF DEVELOPMENT

	Item	Cluster 1	2	3	4
22	Location: on-site	+	+	+	+*
22	Location: near-by	+		+	+
30	Location: with many computers	+	+	+	
31	Length: follow-up	+			
32	Length: ad-hoc	+	+		+
33	Length: ongoing	+	+		
23	Length: one meeting	+	+		+
24	Length: many meetings	+	+	+	+
27	Individualize: many levels	+	+	+	
	vary topics	+	+	+	
3	Incentives: recognition		+	+	
	salary	+	+	+	+
	release time	+	+	+	+
34	Participation: voluntary	+	+	+	
	mandatory		+		
6	Provider: teacher	+	+		
	consultant				
35	Time: during school	+	+	+	
	after school	+	+		
	weekends				
	vacations				
28	Hands-on practice	+	+	+	+

*The plus sign (+) denotes that members of the cluster mentioned the item.

participation in staff development for microcomputer-based instruction was almost always the case, although subtle pressures to participate were apparent in some districts. On the other hand, teachers were nearly unanimous in recommending that microcomputer training be mandatory in preservice education.

Recommendations for Preservice Training

Almost all teachers recommended incorporation of microcomputer-based instruction in preservice education programs. Some said that computers should be included as part of the audio-visual block, while others felt that a semester-long course on computers should be offered.

About half felt that preservice training programs should differ from inservice staff development. Some recommended more breadth in the preservice course, such as learning about and comparing different types of computers, and exploring the variety of ways that computers can be used as teaching tools.

Teachers' recommendations for instruction on programming reflected the current controversy. Their recommendations varied widely, from "an introduction in BASIC to understand the concept of programming" and "enough to be able to modify programs" to "skill in one or two languages...secondary teachers should learn Pascal". An equal number of teachers felt that programming was not at all necessary, or that programming should be required only if it applied to the teacher's subject specialty, such as mathematics or science.

Finally, teachers recommended that preservice training in microcomputers be taught by a practioner who actually used computers in the classroom and that student teachers visit schools using microcomputer-based instruction.

RECOMMENDATIONS FOR STAFF DEVELOPMENT IN MICROCOMPUTER-BASED INSTRUCTION

By considering the literature on staff development, case studies of staff development for microcomputer-based instruction, teacher surveys, recommendations and admonitions obtained from the 60 microcomputer-using teachers in our study and our observations, we have derived a set of recommendations for staff development in microcomputer-based instruction. Many recommendations have already been incorporated into staff-development programs; others are rarely included. Many might be implemented in more than one way, reflecting, in part, district philosophy and resources. Accordingly, these recommendations are not strict prescriptions for staff development programs. Planners need to

consider the recommendations and design staff development activities that best meet their needs and resource constraints.

Recommendations on the Organizational Features of Staff Development

Our conceptual framework provides one way to appraise the value of the organizational features of staff development, both for those activities planned ("forward-looking evaluation") and those activities that have already taken place ("backward-looking evaluation") (Fenstermacher & Berliner, 1983). The framework, when applied for evaluative purposes, includes matching a staff-development activity against the definition of staff development, the salient organizational features of staff development, and the specific conditions that contribute to a valued staff-development program. Our application of this framework as well as data reported in the literature and collected from our sample of teachers led us to consider a number of organizational recommendations, which we repeat and, when needed, elaborate here.

Participation in staff-development activities should be voluntary (34).*

Initiation of staff-development activities should be a collaborative effort of teachers and administrators. This links financial decisions to the needs and experiences of teachers implementing microcomputer-based instruction. Teachers collaborating provide added support for one another (4).

The *objectives* of a staff-development activity should be clearly stated and known to both providers and participants (5). These objectives should reflect both teachers' needs and district goals for microcomputer-based instruction. Both parties should have input into the definition of objectives for staff development.

The *sensibility* condition of our framework leads to the recommendation that the staff-development activity should meet teachers' needs and plans for their work in a timely manner (1).

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* Numbers in parentheses refer to tabled recommendations.

The *application* of the content of staff-development activities to microcomputer-based instruction in the classroom or laboratory should be clear and concrete (7). This includes provision of courseware that is immediately applicable to the teachers' instructional needs. One teacher aptly admonished, "give teachers something they can do on Monday."

The *variability* condition of our framework leads to the recommendation that the staff-development activity should permit teachers to decide whether they will participate, how long they will participate, and how they will apply what they learn (2). Teachers recommended a number of ways this might be accomplished. One way is to individualize instruction as much as possible (27). Another way is to focus each staff-development workshop on a different topic, and to offer programming as a more advanced course for those teachers interested in acquiring this skill. For example, districts might offer courses at different levels, beginning with the core courses (8, 9, 12) and ending with advanced programming. Individualization of staff-development activities, by whatever method, should also help meet the conditions of sensibility (1) and application (7).

The ideal *instructor* is, preferably, someone who is or has been a teacher with extensive experience in microcomputer-based instruction in the classroom and laboratory (7). He or she should be an expert on computers and instructional uses of them, and should be competent in teaching adults. The instructor should be viewed as competent by participants, but not "too technical" or out of touch with the intended beneficiaries of microcomputer-based instruction--the students.

The *duration* of the staff-development program should permit teachers to learn, practice, master, and apply the skills imparted (8). Although the actual time will vary according to the design of the program, our observations and the literature suggest that relatively little time has been devoted to introductory activities--8 to 10 hours spread over three or four sessions is typical. Although this may be sufficient to show teachers how to operate the machine and review some courseware, it often falls short of including other important topics, such as integrating the microcomputer into instruction.

The *maintenance* condition of our framework leads to the recommendation that staff-development activities should be followed up during the period in which the teachers are applying the skills in their classrooms or laboratories (4). Teachers recommended that staff development be ongoing(33)--a multisession (24) initial workshop with follow-up (31). This implies that staff-development activities should be supported by providing enough computers and courseware for "hands-on" practice (28). Moreover, during implementation, teachers need a variety of support services or expert resources to assist with hardware repair, evaluation, selection, and modification of courseware, and day-to-day troubleshooting. At the very least, teacher-networks might be formed to exchange ideas and experiences concerning microcomputer-based instruction (19).

Incentives should be provided in all phases of staff development (workshops and follow up) to support and encourage microcomputer-based instruction (3). However, our results suggest that teachers nominated as successful in microcomputer-based instruction do not participate in staff-development activities because of incentives. One reason was their high level of interest in and commitment to microcomputer-based instruction. Another was that many of these teachers had attained maximum salary levels. A third reason was that such inducements to participate might prompt teachers to participate for the wrong reason.

These findings do not imply the avoidance of incentives. On the contrary, they suggest that the *types of incentives* offered need to be given careful consideration. Release time and, to a much lesser extent, salary credits were standard incentives for staff development in our study. For many teachers, time was more valuable than money. They had many more ideas about how to use computers than they had time to put them into practice. This suggests that time, rather than monetary rewards, might be the major factor in supporting and encouraging successful microcomputer-based instruction.

Recommendations for the Content of Staff Development

The basic staff-development course should include the following topics: operation of the microcomputer (8), selection and evaluation of courseware (10), instructional uses of microcomputers (21), computer literacy (12), and methods for integrating microcomputers with the ongoing curriculum (25). This course might also include computer programming (9), at least to the degree that programming either helps teachers understand how the computer operates, or satisfies the variability condition discussed above.

Operation of the Microcomputer. Instruction in the operation of the microcomputer should include starting the computer, loading and running programs, keyboarding, and minor troubleshooting. The time and effort needed to become a fairly skilled "operator" is trivial; two or three hours is adequate.

Selection and Evaluation of Courseware. Teachers should review a wide range of courseware that is appropriate for their grade level and focus on courseware immediately available for their use. This review should include application of evaluation criteria to the wide variety of courseware packages and selection of high-quality courseware based on the evaluation. Courseware evaluation forms might be developed by teachers and district staff with expert consultation, or evaluation guides might be adopted from those designed for microcomputer-based educational software.

Instructional Uses of Microcomputers. Microcomputer-based instruction involves more than just instruction that can be delivered by a program on tape or disk. Teachers should be exposed to other roles the computer can play, such as a tool for data-analysis or as a tutee to be instructed by students writing or using simple programs (cf Taylor, 1980).

Computer Literacy. Teachers recommended that initial training include computer "literacy." They sought knowledge about the computer such as the history of its development and its uses in society at large. Literacy might also include reviews and evaluations of research on computer-based instruction.

Integration of Computers with Instruction. A critical element of staff development, and one that we saw most lacking in our study, is training on how to integrate microcomputer-based instruction with subject matter and class activities. Simple logistical procedures should be considered, such as rules for student use, transitions between computer and non-computer activities, and grouping strategies. More importantly, teachers need guidance in how to plan the best utilization of the computer in their instruction. They need sufficient information to begin to make reasonable decisions about matching the computer and available courseware to their instructional goals, the structure of the subject matter, the nature of the students, and the content of instruction. Moreover, they need to acquire interactive teaching skills that will help them carry out their plans, monitor and evaluate instructional activities, and make adjustments when required. These decisions and instructional practices, of course, constitute part of what teachers do every day, whether or not they use a computer. Computers, however, introduce an additional order of complexity to teaching.

Computer Programming. We recommend that computer programming be included in introductory staff development to the extent that such knowledge is needed to understand how the computer works and to understand the basis for applying the other recommended skills, such as troubleshooting computer operation. This means that some programming will be an essential part of training, but perhaps to a much lesser extent than many non-teachers would like.

The depth to which programming is taught in an introductory course will depend, in large part, on the variability condition--the extent to which teachers need to know how to program in order to use the microcomputer instructionally. We suspect that mathematics teachers, both elementary and secondary, will need more extensive introductory training in programming than most others because simple programs can be written as tools for solving mathematics problems. We have excluded, for example, science teachers because we suspect that the more complex data analysis programs or simulations often used are too time consuming for students or teachers to develop as part of the regular science course. However, this decision must, ultimately, be made locally.

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